preceding by the absence of barbels and its large scales. Its characteristics are as follows:-

Barbus Sharpeyi. Plate IX. D. 11-12. A. 8. L. lat. 30-31. L. transv. 4/5.

Barbels none. The osseous dorsal ray is rather strong, not serrated behind, and nearly as long as the head (without snout). There are two and a half longitudinal series of scales between the lateral line and the root of the ventral fin. Snout rather short and obtuse. The height of the body is rather more than one fourth of the total length (without caudal), the length of the head two ninths. Origin of the dorsal fin opposite to that of the ventrals. Caudal fin deeply forked. Pharyngeal teeth $5|3| 2$, stont, with rather obtuse crowns. Coloration uniform.

To judge from the number of specimens sent, this species appears to be common. The largest specimen is 13 inches long. Vernacular name " Aradah."
IX.-On the Shull and some other Bones of Loxomma Allmanni. By D. Embleton, M.D., and T'honas Atthey. With four Plates by William Dinning.

> [Plates IV.--VII.]

In the 'Annals,' 1870, v. p. 374 , appeared a paper by our late lamented friend Mr. Albany Hancock and Mr. Atthey, "On the Occurrence of Loxomna Allmami in the Northumberland Coal-field." In the same periodical, 1871, vii. p. 73, and in the 'Nat. Hist. Trans. of Northumb. \& Durh.' vol. iv. pp. 201 (1871) and 390 (1872), they noticed and partially described another skull of Loxomma which had been met with in the same part of that coal-field by Mr. Atthey.

This specimen, being the most complete that has yet been found here or perhaps elsewhere, and wanting but little to make it perfect, demands a detailed description.

The skull has suffered strong compression almost directly downward, with an inclination from right to left.

The upper surface and right border are perfect; but the border of the left maxilla is deficient. The two halves of a lower jaw, right and left, and of the same size, were found near the skull, to which, as they fitted it, they most probably belonged. In addition to the skull and mandible, there were
discovered, at about the same time and place, vertebre, ribs, and bones of the extremities, presumably belonging to the same animal; these were not very numerous, but were by far the most common bones of Labyrinthodonts of any size that were met with ; and they differed thus considerably from those of Anthracosaurus and of Pteroplax, the only other large Labyrinthodonts that have as yet been found in the Nortlumberland eoal-field.

The present paper contains a description of the cranium, mandible, and teeth, and a notice of the vertebro, ribs, and other bones, in the following order-viz. the upper surface of the cranium, the under surface, the oceipital surface, the mandible and teeth, and, lastly, the vertebre, ribs, and bones of the extremities.
I. The upper surface of the skull is represented in Pl. IV. Viewed thus the skull of Loxomma resembles generally that of Archegosaurus and the Crocodilia, and of the latter the alligator rather than the erocodile ; the snout, however, is broader than that of the alligator, as is the whole skull, and the posterior lateral expansions of the cranium for the articulation of the mandible project a good deal further backward beyond the occiput than in the above-named animals.

The length of the skull along the median line, from the end of the snout to the posterior edge of the occiput, is $12 \frac{1}{2}$ inches, from the same point to the end of the lateral expansion above the articular condyle $14 \frac{1}{2}$ inches.

The breadth from side to side at the widest part, which is a little in front of the posterior edge of the occiput, is 8 inches, over the posterior ends of the orbital vacuities 7 inches, over the anterior ends of the same 5 inches, and over the broadest part of the snout $3 \frac{1}{2}$ inches. The snont is broadly rounded off and rather flattened in front.

This upper surface of the skull is all but perfect; the seulpturing, the mucous grooves, the nostrils, the orbital vacuities, the parietal foramen, the temporal fossa leading to the external ears, are all distinct.

Each bone can (more or less clearly) be seen surrounded by suture; the sculptured pattern on the surface is the same as that described in the notice of Loxomma in the ' Nat. Hist. Trans. of Northumb. \& Durh.' vol. iv. pp. 201 (1871) and 390 (1872), namely " the peculiar honeycombed or reticular structure;" but it is distinguishable from that of the other Labyrinthodonts.

On examining closely the hollows or pits of this surface, both of the cranium and mandible, one, two, or three minute but well-defined openings are seen passing into the bone, but
only penetrating its outer table; when three of these exist in the same pit they are placed in a straight line: their use is enigmatical ; perhaps they lodged minute glands for lnbrication of the skin of the head. The skin we infer to have been naked.

The mucous grooves on the bones, of which there are two pairs, run obliquely backward from the margins of the premaxillaries and maxillaries: the premaxillary pair commence at a point midway between the median suture and the opening of the nostrils, and are $2 \frac{1}{2}$ inches apart ; thence they run backward and inward for a quarter of an inch, and are united by a groove running across the median line; beyond this transverse communication they pass almost directly backward for $1 \frac{1}{2}$ inch, and then abruptly cease, having been impressed for the last half inch upon the nasal bones: the maxillary pair, arising on the margins of the maxillary bones, a short way behind the widest part of the snout and about a quarter of an inch behind the openings of the nostrils, run obliquely backward and slightly outward on the maxillo, and are discontinued on the edges of the lachrymal bones.

The nostrils lie, therefore, between the premaxillary and the maxillary mucons groove of each side, but nearer to the latter than to the former. They are openings of about $\frac{1}{2}$ inch diameter, nearly circular, and bounded in front by the premaxillaries, behind by the maxillaries, and internally by the nasal bones; their central points are 3 inches apart ; and a line drawn across the nasal region between these points is nearly 2 inches behind the mid point of the snout. They are only about a quarter of an inch removed from the margin of the jaw.

The orbital vaouties are large, irregularly elliptical in outline, and diverge slightly from each other in front; each measures $4 \frac{1}{2}$ inches in length, and $1 \frac{1}{2}$ inch across the broadest part. The true orbits occupied only a portion of the vacuities at the posterior and inner part, as indicated by two nearly opposite and slightly prominent points on each margin, which are best seen on the left side of the figure on Pl. IV.; to these points ligaments and membranes, defining in front the proper spaces for the eyes, had been attached; on the right side the malar bone has been partially dislocated, and its imer edge driven a short way into the vacuity.

The parietal foramen, rather over $\frac{1}{8}$ inch in diameter, is formed equally by the parietal bones at the mion of the posterior third with the anterior two thirds of the interparietal suture. It is circular, perforates the top of the cranimm, and opens below as a smooth, inverted funnel-slaped cavity.

The broad channels or fosse leading to the external auditory openings (the temporal fosse) are bounded on the imner side by the squamous and mastoid bones, and, notwithstanding that the skull has been subjected to immense pressure, are still seen to be at a somewhat lower level than those bones. They pass forward for about an inch from the external posterior angle of the mastoid, are rom their floor becoming gradually more superficial on the supratemporal bones; these constitute nearly the whole of their floor, the narrow parts of which left on the inner sides are supplied by the ossa quadrata.

External to these fossa, extend broadly outward and backward, for nearly 2 inches behind the posterior border of the occiput, the posterior expansions of the sides of the cranium, or extensions of the maxillæ.

Individual bones.-These can be distinguished, with a little trouble, by obscrving the lines of suture along which they are united.

The premaxillaries form the whole of the front of the snont, and are firmly united on the median line; they are bounded behind, on each side of the mouth, by a small portion of the maxillaries, which in part they overlap; further in, by the nasal orifices, and next by the nasal bones.

The maxillaries occupy the edge of the upper jaw, from the onter ends of the premaxillaries and the nasal orifices to the suture uniting the malar and quadrate jugals, a distance of $9 \frac{1}{2}$ inches; they are scen from above as far as a point nearly opposite to the middle of the length of the orbital vacuities. These bones nowhere measure more than $\frac{3}{4}$ inch in breadth; behind the broadest part they rapidly become narrower, and form a mere bordering to the jaw, and are only here and there visible from above. Their inner borders unite in front for an inch with the nasals, then for 23 inches with the lacrymals, and further back with the malars.

They belong mainly to the under surface of the cranium, and will be noticed again in the description of that part.

The nasals lie immediately behind the middle of the premaxillaries and before the frontals; they are more expanded in front than behind, contributing to keep up the breadth of the muzzle, and occupying the whole space between the nasal orifices; they are bounded on their outer sides by the maxillaries, lacrymals, and prefrontals.

The lacrymals are wedge-shaped and pointed in front, occupying the angles left by the maxillaries and nasals, and are cleft behind, the outer division being larger than the inner, to enclose the anterior angles of the orbital openings. They
are bounded by the nasals and prefrontals at their inner, and by the maxillaries and malars at their outer border.

The frontals are narrow and elongated, slightly broader behind than before, united in front to the nasals, behind to the parietals, and on their outsides to the prefrontals for three fourths of their length, and to the postfrontals for the remaining one fourth. The median suture unites thom to each other.

The prefiontals, elongated and about half as wide as the frontals, become gradually wider from back to front; they rest upon the postfrontals behind, upon three fourths of the frontals at their inner sides, and form three fourths of the inner edges of the orbital openings at their outer side. Just in front of the suture uniting the pre- and postfrontals, at the outer margins of the bones is a small but distinct prominence, marking the boundary, on that side, of the true orbit. In front, the sharply wedge-shaped ends of the prefrontals are received into retreating angles formed by the diverging sides of the nasals and lacrymals.

The postfiontals are rather more than half the length of the prefrontals, somewhat hatchet-shaped, the handle forwards, and joining the prefrontals; their inner edges are bounded almost equally by the frontals and parietals; posteriorly they abut upon the squamous bones, and externally, besides joining with the postorbitals, form smooth rounded concave edges, which look outwards and forwards, and constitute a considerable part of the inner border of the true orbit.

The parietals are a good deal slorter, but on the whole broader, than the frontals, with the posterior borders of which they articulate. They are much broader behind than in front, and are joined outside by the postfrontals and squamons bones, and behind with the pair of bones to be next mentioned.

The parietal foramen has been already noticed.
The pair of bones next behind and articulating with the parietals, and which, united on the median line, overhang the occipital segment of the skull, as the parictals themselves in most Vertebrata do, correspond to the pair called "supraoccipitals " by Von Meyer in his description of Archegosazirus, in his work entitled 'Reptilien aus der Steinkohlen-Formation in Deutschland.' They are irregular squares of about $\frac{3}{4}$ inch on a side; their outer borders are bounded for a short space anteriorly by the squamous, and further back by the mastoids; behind they articulate on each side of the median line with the upper border of what appears to be the true supraoccipital, and, further out, slightly with the exoccipitals. They form with the mastoids the posterior border of the top of the cranium.

These bones do not exist in the Crocodilia or in the great majority of fishes, though they are present not only in Loxomma and Archegosaurus but also in Pteroplax; they do not appear either to form a part of the skull in any other of the Labyrinthodonts. Occasion will be taken to notice these bones more at length under Section III. Occipital Surface.

The mastoids, which are squares of $\frac{3}{4}$ inch, and form the posterior external angles of the upper middle cranial surface, lie external to, and join with, the last noticed bones; in front they abut upon the squamous bones; externally they are free, and bound the posterior part of the imner margins of the fossa leading to the ears.

At the back part of the mastoids, and close under their external angle, is a somewhat obtusely pointed tooth-like process, directed backwards from the under surface of the bone, and marked by muscular impressions.

The squamous bones, of an irregular shape, lie external to the parietal, and form the anterior curved margins of the temporal fossa, having the postorbital and the supratemporal (Huxley), the tympanic (Von Meyer), on their outer side. They are connected in front with the postfrontal and postorbital, and behind with the mastoids. By a small posterior part of their inner margins they are sutured to the so-called "supraoccipitals."

The postorbitals are of a somewhat rhomboidal outline; their anterior internal borders, concave, form the posterior and external margins of the true orbits; their inner angles, which are truneated, abut upon the postfrontals, which bound the orbits posteriorly and internally. These two bones (the postorbital and postfirontal), with a small portion of the posterior end of the prefrontal, form the whole of the bony margin of the true orbit. The anterior angles of the postorbitals project into the orbital vacuities, marking on their outer margins the boundary of the thne orbit, as noticed already under the heading "orbital vacuities." The postorbitals articulate by their imucr and posterior sides with the squamons, and by their outer and posterior with the supratemporal of Huxley, the tympanic of Von Meyer. Their remaining sides, the anterior and the external, join with the jugal bones.

The malars or jugals, much elongated, form the middle two thirds of the external borders of the orbital vacuities (on the right side the bone, as already noticed, has been partially dislocated), and overlap by their external borders nearly 6 inches of the borders of the maxillaries: they grow narrower as they extend forward, and have a pointed end received into the angle formed by the diverging posterior edges of the max-
illaries and lacrymals; extending backwards they become rapidly broader, and cease posteriorly in an obliquely running zigzag line of suture, which unites them, from within outwards, to the postorbitals, the supratemporals, and the quadrate jugals. The external borders of this upper surface of the maxillary part of the cranium are formed largely by these bones, and are completed in front by the maxillaries and premaxillaries, and behind by the bones next to be noticed.

The quadrate jugals, oblong in shape, complete the posterior three inches of the external, somewhat convex border of the maxillary part of the cranium; they articulate by their anterior ends with the malar, and by their internal edges, also convex, with the supratemporal, a small portion of this line of suture being reserved at the back part for connexion with the quadrates, together with which they form the great posterior external angle of the skull.

The supratemporals are mueh larger than the quadrate jugals, and are of an irregular oblong shape; they are bounded in front by the postorbitals and malars, externally by the malars and quadrate jugals; and posteriorly they overlap the quadrates. On their inner side they are opposed, first and in front, to the postorbitals, then to the squamous bones, and form, as before said, the greater part of the floor of the temporal fosse, where they overlap considerably the quadrates.

The quadrate bones form only a narrow slip of the imer side of the floor of the temporal fosse, and stretch as a rather narrow and irregular border outwards and backwards to join the quadrate jugals; these form the extreme external angle of the skull.

The quadrates enter more largely into the formation of the under surface of the skull, and there, at the external angle, form the condyles for articulation with the mandible, and will be further described with the rest of the under surface.
II. Under surface of Skiull (Plate V.).-The dimensions are here the same as those of the upper surface. The whole of the alveolar border of the left maxilla is wanting, except about two inches of the posterior end; and there are therefore on this side no maxillary teeth remaining. The right maxilla is very nearly perfect. The whole of the middle and posterior part of the palate is much depressed, except along the median line, where, for four inches from the posterior edge of the palate, exists a narrow ridge, formed apparently of the basal part of the presphenoid and perhaps of the vomer; from this ridge the palate-bones on each side have been broken off and pressed down to a lower level. At the beginning of the posterior third of this ridge there is an oblique fracture through the
presphenoidal part; in front of the fracture the ridge tapers gradually to a point, which is probably the anterior end of the median part of the vomer, and where it is joined by the vomerine palate-plates.

The teeth are all broken off at about the level of the alveoli, except four on the right side. The whole surface of the palate between the palate-plates of the maxillaries, (namely, the palate-plates of the palate-bones and of the vomers) are covered all over with small, somewhat pointed, and thickly set granulations; the vomerine and premaxillary divisions of the palate are the strongest parts of the upper jaw. There is no anterior palatine foramen.

The malar or zyyomatic arches are open and wide, being about 4 inches long by 2 inches at the widest part, and of an elongated ovoid shape, their apices pointing forwards.

The posterior nures are placed far back, at the posterior part of the pterygoids, and close together, but distinct from each other.

Behind the nares are two bony projections, apparently from the basisphenoid; this bone is difficult to define, but is attached to the apex of the basioccipital behind. This is of a triangular form; and its forward-pointing apex is wedged in between the converging posterior lateral projections of the cranium, bordered by the ossa quadrata. At its base is seen the cup-shaped cavity for articulation with the body of the atlas.

Individual bones.-The premaxillaries are well preserved, and are firmly united by the median suture; their alveolar border or arch is somewhat elevated above their palate-plates, and contains four teeth on each side of the symphysis; all are broken off on a level with the alveoli.

In another specimen of Loxomma in Mr. Atthey's possession there are five teeth on the right and six on the left side.

The last two teeth at the extremities of the premaxillary arch are only half the size of the others, and are placed nearer to each other than the rest are.

Each dental interspace is fully occupied by a wide and deep depression, which varies in size with the distance at which the teeth are apart. These depressions, it has been said, are destined for the reception of the points of the mandibular teeth when the mouth is closed; as, however, we doubted the correctness of the assertion, Mr. Atthey made transverse sections through these depressed spaces and the adjacent parts of the jaw, taking in some of the teeth; and then, under a low mag-nifying-power, we discovered in each case, a little below the surface of the depression, the remains of the root of a former
tooth. Depressions of the same character existing along the alveolar border of the maxille were next, in several instances, similarly examined in section, and with the same result; the remains of a tooth existed in each. These depressions, therefore, instead of lodging the teeth of the other javv during closure of the month, are the restiges of former alveoli from which old teeth have been shed. Besides, it can be shown that the teeth of the mandible are not received into these depressions when the mouth is closed; for the upper jaw, forming the larger arch, must, when the mouth is shut, enclose the corresponding part of the mandible; moreover the teeth of the mandible, when the mouth is closed, do not otherwise correspond to the depressions of the maxilla.

The median suture between the premaxillaries is distinct, and is thence contimued backward, first between the vomerine palate-plates and then between those of the palate-bones and the pterygoids as far as the posterior border of these last.

At the posterior border of the premaxillaries this suture is crossed by a transverse one, miting these bones with the vomerine plates. The latter suture is projected forwards on the median line by a rounded prominence of the vomers ; from this on each side it curves forward and outward and then backward, thus surrounding a considerable part of the base of the vomerine tusk, from which it is distant only about an eighth of an inch. It terminates at the borders of the jaw, uniting at that part the contignous ends of the premaxillaries and of the alveolar borders of the maxillaries.

The vomers, immediately behind the premaxillaries, stretch almost entirely across the palate, and are separated from the border of the jaw only by a narrow strip of the maxillary alveolar border; their external anterior angles have the large tusks, hence called vomerine, implanted in them: behind each of these is a large depression, each a little larger than the base of the tusk, and resembling those of the premaxillary interdental spaces ; and further back there is an aperture on each side in the jaw, presently to be noticed.

The outer borders of the vomers are next directed backwards and inwards for about $1 \frac{1}{2}$ inch; thence they run abruptly inwards and forwards, converging to the median line of the palate. The angles they thus form together are inserted between the palate-bones on the inner and the maxillaries on the outer sides.

The vomerine tusks present a clean fracture of circular outline, with a diameter of $\frac{7}{10}$ by $\frac{5}{10}$ inch.

The apertures above noticed in the jaw are obscure; they do not pass through the jaw to its upper surface, but
merely picree the nasal cavity. They are not in comexion with the anterior nares. In Lepidostens, a short way behind the snout, there is, on each side of the median line, a complete perforation of the maxilla for the reception of a mandibular tooth during closure of the mouth. Perhaps the apertures in Loxomma have the same use; they are of about the same size as the depressions in front of them, and are bounded internally and in front by the vomers, externally by the alveolar borders of the maxillæ, and posteriorly by the anterior ends of the palate-plates of the same bones.

The maxillaries are the longest bones of the skull, and consist of alveolar borders and palate-plates. On the right side the alveolar border of the bone is very nearly perfect, whilst that on the left side is nearly all wanting. The palate-plates are perfect on both sides.

The alveolar border is a narrow tract of bone, $8 \frac{1}{2}$ inches long, extending from the premaxillary to the quadrate jugal, with which latter it articulates at about $3 \frac{1}{2}$ inches in front of the posterior end of the lateral part of the cranium. The border which remains bears thirteen small tecth irregularly disposed, and has four gaps from which both bone and teeth have disappeared. It is highly probable that the tecth had originally been more numerous; for in another specimen, in Mrr. Atthey's collection, of the skull of Loxomma, in which the maxilla measured in length very nearly the same as that of the specimen before us, there were twenty-four teeth easily counted.

The imner edge of the alvcolar border towards the front is depressed for the space of $1 \frac{3}{4}$ inch below the level of the outer.

The palate-plates of the maxillaries are about $6 \frac{1}{2}$ inches in length, with an average width of 1 inch, and extend from the aperture in the jaw and the vomerine plates backwards to articulate with the malars and ectopterygoids. Each is transversely divided into two, if not three, pieces, there being an undoubted suture at the distance of 2 inches from the anterior end of the bone, and a doubtful one at nearly the same distance further back; the supposed third picce bears no tooth.

The first piece of the palate-plate, a little broader than the others, lies between the alveolar border externally and the vomers and palate-bones internally; in front it forms the posterior margin of the aperture in the jaw ; and immediately behind this edge occur's a large round depression, behind which again is a tusk, but one of smaller diameter than the depression ; the tusk is only $\frac{3}{4}$ inch in diameter, and its outline is more circular than that of the vomerine tusk.

The second piece is bomded laterally by the alveolar border and by the palate-bones, and bears, at a distance of $1 \frac{1}{4} \mathrm{inch}$
behind the last-named tusk, another, which has a diameter of only $\frac{1}{2}$ inch ; and behind this is a depression much larger than the tusk itself.

The third piece, indistinctly divided from the second, is bounded laterally by the alveolar border and the malar cxternally and the palate and ectopterygoid internally; and its posterior extremity forms a small portion of the anterior boundary of the zygomatic arch.

The palate-bones are long and rather broad, occupying a large space on each side of the median line; together they have an ovate-lanceolate form, pointed in front and inclosed on each side for about an inch by the vomers, behind this by the palate-plates of the maxillaries, and next by the ectopterygoids. Their posterior ends abut upon the pterygoids ; but no connecting suture can be made out.

Had the skull not been so much erushed, these bones would have been found united by suture along the whole of their inner edges; as it is, they have, as before mentioned, been dislocated from the lower edge of the vomer and presphenoid for a considerable distance along the median line, and can be observed lying apart with their serrated edges well preserved, whilst the presphenoid and vomer form the ridge already named as projecting between them.

At the posterior termination of this ridge two pits, one on each side of the median line, mark the position of the posterior nares. Behind these are two projections opposite to each other and about $\frac{1}{2}$ inch apart, probably belonging to the basisphenoid ; they are sharply defined posteriorly and internally, and slope downwards on their anterior and external sides. A welldefined smooth groove or channel runs along their bases on the inner and posterior sides from before backwards and is soon lost. A distinct suture follows this groove, lying on its outer edge. The grooves seem adapted for vessels or nerves; or it may be that they are vestiges of the lateral Eustachian tubes.

A transverse suture connects the posterior end of the median ridge before noticed to that part of the base of the skull immediately behind, which appears to be the basisphenoid, as it articulates or is continuous posteriorly with the apex of the basioccipital. The basisphenoid is difficult of definition, owing to the crushed state of the skull.

The basioccipital. This is the somewhat triangular piece, which, by its forwardly placed apex, articulates with the basisphenoid: its sides articulate with the quadrates; and its base is occupied by a deep cup-shaped cavity (in place of the convex condyles found in the other Reptilia) for articulation with the
body of the first cervical vertebra. The surface of the bone in front of the articular cavity is smooth and slightly convex; its sides, somewhat rough, are overlapped a little by the quadrate bones.

The articular cavity, much compressed, has an oval contour; its transverse diameter is $1_{\frac{4}{10}}$ inch, and its depth considerable. In several other specimens of the basioccipital in Mr. Atthey's collection its outline is more regularly circular; these specimens are of various sizes, having belonged to examples of different ages.

Behind and below the cotyloid cavity are partially seen the facets of the exoccipitals for articulation with the neural arch of the atlas. The foramen magnum is not visible in this view.

The quadrate bones can be distinguished as bounding by their inner borders the basioccipital triangle and the cotyloid cavity, and then rumning outward and backward to the posterior external angle of the cranium, joining there with the quadrate jugals and constituting the condyles for the mandibular joints. The condyles are ahmost transversely placed, but have a slight inclination forwards at their inner ends, about $1 \frac{1}{4}$ inch long, rounded from before backwards, and their ends somewhat raised above the middle, which is slightly depressed.

The quadrates at their internal ends are broad, and become gradually narrower as they are traced outwards to the condyles, where they are again enlarged. Their outer borders form a considerable part of the imer margin of the zygomatic arch ; in front they appear to articulate with the basisphenoid and ectopterygoids and perhaps also with the pterygoids; but it is impossible clearly to make out these parts. On the left side the anterior terminations of the quadrate are hidden by the ectopterygoid, which has been dislocated and thrown over them.

The ectopterygoids complete the sides and back part of the bony palate by uniting with the palate-bones and the pterygoid; but the lines of comexion are not visible.

They are rather broad and strong and articulate behind with the quadrates; directed thence outwards and forwards they are sutured to the posterior internal extremity of the palate-plates of the maxillaries.

The malar or zygomatic arches, as seen from below, are thus circumscribed by the ectopterygoids, the posterior ends of the palate-plates of the maxillaries, and a portion of the alveolar border of the same bones, by the malars, quadrate jugals, and quadrate bones.

The inferior surface of another skull in Mr. Atthey's colAnn.\& Mag. N. Hist. Ser.4. Vol. xiv. 4
lection is shown, of natural size, in Plate VI. fig. 1. The posterior part only is given.
III. The Occipital Surface.-It is impossible to estimate the height of the occiput, owing to the crushing it has undergone; it is much flattened, concave on the whole from side to side (that is, from the posterior external angle of one mastoid to that of the other) ; external to the occipipt project backwards and outwards on each side the posterior lateral angles of the maxillary part of the cranium.

The upper border of the occipital surface is also the posterior border of the middle part of the skull, and overhangs slightly the parts beneath it. It is formed externally by the mastoids and between them by the pair of bones corresponding to those which, in Archegosourus, are called by Von Meyer, in his work before quoted, "supraoccipitals." Immediately below this border runs a transverse line of suture connecting the bones forming the border with those beneath it-namely, next the median line with the single and, as we deem it, the true supraoccipital, and laterally with the exoccipitals.

The supraoccipital is of a subtriangular form, wider from side to side than from above downwards, and situated on the median line. It is doubtful whether or not the median suture passes through it. Below it articulates with the exoccipitals.

The exoccipitals are a pair united by suture on the median line below the supraoccipital; they form the upper portion and sides of the foramen magnum; their upper borders articulate next the median line with the supraoccipital and then with the supraoccipitals of Von Meyer, and further out with the mastoids ; their lower borders, external to the foramen magnum, rest upon the basioccipital, and have on each a projection posteriorly, terminated at its inner side by a flat rounded articular facet looking backwards, for articulation, doubtless, with the neural arch of the atlas. Betreen these facets is a notch, the uppermost part of the foramen magnum ; the lowest part of the foramen is the upper edge of the cotyloid cavity of the basioccipital. Owing to the compression of the skull, the foramen, however, is not easily made out.

External to the facets there is on each side a rather pointed process, apparently for muscular attachment; and beyond these again, at a short distance, are the tooth-like processes of the underside of the mastoids, mentioned in the description of the upper surface of the skull.

Below these parts is the inferior surface of the skull, described in section II.
IV. The Mandible (Plate VI. figs. 2 \& 3 ). -Two half-mandibles, right and left, occurred, as is stated at the commence-
ment of this description, 2 or 3 feet apart and not far from the skull; they are of the proper size to fit it, and most probably belonged to it.

The right half (fig. 2, half the natural size) is almost perfect ; its alveolar border is quite so; it exhibits the teeth in a beautiful state of preservation; and its exterior is covered with the peculiar reticular sculpture. It measures nearly $14 \frac{1}{2}$ inches in length, and at the widest part, which is about 4 inches from the posterior end, $2 \frac{3}{4}$ inches in width; from this point it tapers gradually to the anterior end, where it is perfect and little more than an inch in width.

A narrow groove can be observed to run nearly the whole way along the inferior border of the specimen, begiming below the articular projection; whether this is a mucous groove, or what its signification is, is not easily determined.

The inferior margin is slightly convex; the upper or alveolar somewhat concave, with a slight eminence in front supporting the first large tooth. The anterior end terminates in a symphysis which is rather deep, and, as seen in another specimen, extended downwards and backwards, its depth being $1 \frac{3}{4}$ inch, its breadth at top $\frac{5}{8}$ inch, below which it lessens to $\frac{1}{4}$ inch.

Near the posterior end the outer layer of the bone in our specimen is for a short space altogether wanting; but beyond this the articular end is well preserved, at least at the outer side. From this specimen, and from another in Mr. Atthey's possession, it can be discerned that the articular surface was a rather deep, transversely clongated, and smooth groove, rather more elevated in the middle than at the ends, for the reception of the condyle of the upper jaw, which was similarly elongated, and whose ends were gently raised above the level of the middle.

In another specimen in MIr. Atthey's collection, larger than the subject of this paper, the length of the articular groove on the mandible is $1 \frac{3}{4}$ inch, the breadth $\frac{1}{2}$ inch, and the greatest depth $\frac{1}{4}$ inch. The posterior border of the articular surface curves upwards and forwards, so that the joint, thongh it was not interlocked, must have been pretty secure. The articular part of the jaw projects outwards from the plane of the ramus half an inch. The inner surface is not visible in this, but can be well seen in the other half-mandible.

It will be observed that the teeth in the right half are all entire, whilst those of both sides of the maxilla and, as will be seen in the sequel, those in the left half-mandible are all broken off short. The difference is thus accounted for: in the matrix they were all eutire; but on this being broken up,
the teeth, being firmly anchylosed to their sockets, could not come out; but the parts above the alveoli, being firmly imbedded and entangled in the matrix, have been broken away with it and lost; moreover the weakest part of the teeth is immediately above the alveolar border. In the case of the right half-mandible, which was obtained with the shate around it, this matrix has been carefully worked and cantiously chipped away, leaving the teeth in situ, exposed on their outer surface, but left supported by the shate on the other side.

There are upwards of twenty teeth in this half-jaw : seventeen or eighteen are well preserved; a dozen are entire. They vary much in size, and are irregularly arranged, in some parts being nearly in contact with each other, in others considerably apart. Three are much larger than the rest, and seem to correspond to the vomerine and palatal tusks of the upper jaw. These large teeth are $1 \frac{1}{2}$ inch long, and upwards of $\frac{1}{2}$ inch across at their bases. The first is placed an inch from the anterior end, upon the eminence ahready noticed as cxisting on the alveolar border ; a single small tooth exists in front of this. The second large tooth is 2 inches further back, and the third $1 \frac{1}{8}$ inch behind the second ; the third is therefore $3 \frac{3}{8}$ inches behind the first; but the apices of these two are $4 \frac{1}{4}$ inches apart-a distance very nearly corresponding to that between the depressions behind the vomerine and last palatal teeth of the maxilla. No interdental depressions are visible on this exterior surface. The smaller teeth vary from $\frac{3}{8}$ to about $\frac{3}{4}$ inch in length.

The left half-mandible, Plate VI. fig. 3 (represented half the natural size of the fragment), has been crushed, and the posterior part broken off and lost. The greater part, however, 9 inches in length (the anterior end), remains in a good state (see vol. iv. 'Nat. Hist. Trans. of Northumberland and Durham,' 1872, p. 392).

This fragment shows both inner and outer surfaces, and contains twelve teeth, of which three only are large; several gaps exist in the row, the teeth being irregularly placed.

The teeth as seen from the outer surface are, with one exception, broken off on a level with the outer alveolar border ; but if we look at the imner surface, the alveolar border there is found to lie at a much lower level than the outer, forming a concave irregular line 7 inches long along the jaw, extending from the front of the third tooth backwards to the fractured end ; it descends gradually towards the middle of the jaw, and then similarly rises, approximating to the level of the outer border. This deficiency of the inner border, which at first
looks like a fracture, exposes the inner surface of the teeth as far as to near their roots, and the depressions between the teeth appear as if in section.

The exposed surfaces of the teeth are closely invested, however, by a thin layer of osseous tissue continuous with that covering the surfaces of the depressions, and the inner alveolar border has not in reality been broken off. The teeth of this half-mandible are differently arranged as to size and position from those of the right half.

The row of teeth begins in front, as in the other halfmandible, with a small one; next to this comes the largest tusk, behind and internal to which is the largest depression, of a nearly circular outline; next come two small teeth with a very narrow depressed interval between them; and below the former of these it is that the alveolar border begins slightly to be deficient; then we have the second depression, followed by two teeth separated by a depression broader than the last: immediately behind the latter of these two teeth is a large and, as it were, double and deep depression $1 \frac{1}{4}$ inch broad; this is succeeded by three tusks separated from each other by two large depressions; after the last of these three tusks is a broad depression followed by a rather small tooth; lastly, behind this are two other teeth still smaller, with very short intervals between them; and the fractured end of the bone occurs directly after the latter of these teeth.

The teeth (Plate VII. figs. 2, 3, 4, 5, 6). With the exception of four on the right side of the cranium, three of which belong to the maxillary and one to the premaxillary, nearly half of the teeth of the right ramus, and one of the left half are broken off, as before stated. Their fracture is transverse, giving a circular outline, within which can be roughly seen their beautiful labyrinthodont structure. Several other specimens, however, of Loxomma have been found, of which the teeth are entire.

The size of the teeth varies both in the upper and the lower jaw, those of the vomerine plates and of the palate-plates of the maxillaries being much larger than those of the alveolar borders of the maxillaries and premaxillaries; the second tooth of the left half of the lower jaw is much larger than any of the others of that part; the ninth, the seventh, and the eighth come next in order of size, and occupy a middle position in the ramus. In the right half, the second, eighth, and twelfth are the largest, differing but little in size from each other, and the sixth is next; the twelfth is in advance of the middle of the jaw. The teeth of the mandible are more deeply socketed than those of the maxilla; all are expanded at the
bottom of the alveoli, and gradually become continuous with, and anchylosed to, the bone at that part.

Each tooth, for about one fourth of its length above the border of the alveolns, is circular and of uniform diameter ; in the upper three fourths it is compressed on its immer and onter sides, so that its anterior and posterior edges become sharp and cutting, maintaining at the same time the width of the lower part of the tooth. It is longitudinally grooved all round on its outer surface for about one third of its length from the alveolar border, and is abruptly pointed at the apex.

Some of the teeth are very slightly curved inwards towards the point. From the apex to within the border of the alveolus the tooth is clothed with a very thin layer of enamel, which appears structureless.

The internal structure of the teeth has been carefully drawn by Mr. Dinning in Plate VII., in which fig. 2 shows a perpendicular or longitudinal section, in a line with the jaw, of one of the posterior mandibular teeth, at the imer side of its centre, and carried through the contiguous parts of the thin band of bone mentioned as enclosing the lower part of the tooth. The longitudinal and slightly converging pillars or lines lying on each side of the pulp-cavity are the converging plates of dentine, the plicæ, seen in the transverse section, fig. 5. These plates or lines represent the labyrinthodont arrangement of the constituents of the tooth; and their upper terminations show the distance to which that peculiar structure extends-namely, somewhat less than two thirds of the whole length of the tooth.

The anchylosis of the tooth to the jaw is also seen in fig. 2; the tooth-structures at the base are, every here and there, interlocked or dovetailed more or less deeply and curiously into the bone, in which they are gradually lost; but above the base the sides of the tooth keep distinct from the alveolus and are smooth.

Fig. 3, Plate VII., is a transverse section a little way below the apex; its outline is fusiform; and its extremities, one of which is rather more pointed than the other, are parts of the cutting-edges of the tooth; the dentine is enclosed by a thin plate of enamel, and encloses the small prolongation of the pulp-cavity.

Fig. 4 of the same Plate is a transverse section near the top of the wider part of the pulp-cavity, and above the cessation of the radiating branches of the pulp-cavity; the arrangement of the dentine is still peculiar.

In Plate VII., fig. 5 represents a transverse section of a maxillary tooth (marked in Plate V., left side of figure,
"section"), made a little below the borders of its alveolus, which are of equal height. In the centre is the somewhat oval pulp-cavity, which is pretty large as compared with that of Labyrinthodon Jegeri, tigured in Prof. Owen's 'Palæontology;' from it pass off, radiating towards the periphery, nunerous chamels, separated from each other by the inwardly projecting plice or "infoldings" of the external layers of the tooth. The pulp-cavity and its radiations, being clear and colourless spaces, contrast well with the plicæ, which are brownish yellow, the osseous tissue around the tooth being of a lighter yellow.

The solid part of the tooth appears in the section to be arranged as a nearly circular series of toothlets or denticles, whose external margins or crowns, rounded but somewhat flattened, constitute the ridges seen on the outside of the tooth; they vary a good deal in size, and in one specimen number forty-one, in another forty-three. The concave internal margins, facing the centre of the tooth, correspond to and embrace the rounded, somewhat expanded ends of the radiations of the central pulp-cavity, each of which serves as the pulp-cavity of a toothlet, whose fangs are on each side of the space: each side of every toothlet is incorporated with that of its next neighbour ; and these united are inflected towards the central pulp-cavity forming the plica, which divide the radiations of the pulp-cavity from each other ; these plice are, of course, sections of the vertical plates shown at fig. 2 in Plate VII.

They vary much in length, the longest forming, by their imner ends, a series of over twenty blunt projections, like radii of a circle, pointing to the centre of the pulp-cavity; the shortest are mere mammillary processes, enclosed between the bases of the longer ones; and there are others of intermediate but different lengths. They pass in from the periphery at first, for a short distance, straight, but soon form undulating and then zigzag curves, which continue to the end, where, in places, two or more may be seen minited.

Each concavity on the undulating sides of the plicer answers to a secondary offiset of the pulp-cavity; and the dentine partially surrounding these little bays is disposed as a secondary toothlet, of which the bay is its particular pulp-cavity.

If now with the aid of a $\frac{1}{4}$-inch object-glass (Powell and Lealand's) we look at the dilated end of one of the primary prolongations of the central pulp-cavity, which serves as a pulp-cavity to a toothlet, we see the tubules of the dentine radiating from its margin through a series of finely arched lines towards the crown and sides of the toothlet; before, however, reaching the outer borders of these, they pass
into a dark granular-looking layer, which is parallel to the crown and sides, and in some toothlets double. This layer consists of black lines forming a close network, the meshes of which are minute and look like cells, giving this layer its black and granular aspect. It is usnally well defined on its external side ; but towards the pulp-cavity it is in many parts gradually thinned away, and continued, here and there, a good way into the tubular dentine; in such situations the lines often lose their dark colour, and resemble the tubes of dentine, with which it is not difficult to observe that they are continuous. The dentinal tubules can here and there be seen as black lines approaching the dark network; some can be observed to divide into two, as is common in human dentine. Many (perhaps all) of the dentinal tubes are thus, as it were, arrested in their straight course by the black layer.

Beyond this is a narrower and lighter-coloured tract, which forms the external boundary of the crown and sides of the toothlet; in it numerous closely set straight lines or tubules, mostly pale, but some black, and of the same size as those of the black layer, are visible, passing out of that layer to the exterior surface of the tooth. Thus the whole thickness of the crown of the toothlet is composed of tubular and granular dentine. The gramular or nodular layer corresponds to that seen and often figured as commonly existing in the fang and other parts of the human tooth, and which is commonly black, but at times light-coloured.

In the tooth of Loxomma nothing like an external layer of cement is anywhere visible.

If we examine in any of our sections one of the grooves on the exterior of the tooth, we find it filled with a wedge-shaped portion of osseous tissue; but this does not pass beyond the bottom of the groove: the sides of the groove are formed by the adjacent borders of two toothlets; these approach each other at an acute angle, coalesce, and the resultant band passes inwards to the interior of a plica, being somewhat narrower than its constituents together before coalescence. The straight and short dentinal tubes (some pale, others black) are very distinctly seen on the margins of the groove.

The black granular layer of each of the two toothlets is bent inwards, and passes into the plica, one on each side of the now central band, which is of light colour, and forms, as it were, the core of the plica. At first, for a short distance, straight, the central band becomes wavy, and then, in most of the long plicæ, zigzag ; and from each of the angles a straight process is given off laterally, and ends in a blunt point, which partially separates two secondary toothlets. The
concavities of these undulations and zigzags correspond to the concavities of the borders of the plica, and therefore to the secondary pulp-cavities before mentioned.

The granular layer accompanies everywhere on each side the sinuosities of the central band and its processes, and holds the same relation to the tubular dentine of the secondary toothlets as it does to the same tissue of the toothlets of the exterior of the tooth; and it can anywhere be seen that the dentinal tubules have a similar course through that layer to the central band.

On scrutinizing closely the pale central band of a plica with a $\frac{1}{8}$-inch olject-glass, the tubules of dentine are clearly seen at its margins; many of them end there, or perhaps are cut off, whilst others (mostly, but not always or everywhere, colourless) are distinctly observed to cross over the pale band and unite with those of the other side, either as straight tubes, or forming with them a delicate and pale network, resembling that of the granular layer, but devoid of its colour.
V. The other bones of Loxomma that have been picked up are as follows:-eighteen separate centra of vertebre, and twenty others imbedded more or less in slabs of shale in company with entire or fragmentary ribs; twenty-four ribs, of which a good many are nearly perfect, showing the head and tubercle; and seventecn bones of the extremities, one of which is a humerus, the rest digital, large and small. All these bones are well ossified, and their articular surfaces mostly perfect.

The centra of the vertebre are commonly of considerable size, alternately larger and smaller, strongly compacted, and have the anterior and posterior surfaces concave, the former being less so than the latter; several show no facets for the heads of ribs.

The vertebral canal, where it can be seen, is small. The arches are therefore short, but strong, and unite above in a broad and high, but thin, spinous process; this is entire in only one specimen, but nearly perfect in two or three others; it stands up straight, inclining neither forward nor backward. All parts of the vertebre are well ossified.

The following are the measurements of the vertebra, a dorsal, which is the most perfect, and is figured in Plate VI. fig. 4:-Length of the body $\frac{11}{16}$ inch, transverse diaméter $1 \frac{5}{16}$ inch, vertical diameter $1 \frac{7}{16}$ inch ; height of neural arch $\frac{5}{16}$ inch, height of spinous process 2 inches, length of same from front to back $1 \frac{5}{106}$ inch, thickness $\frac{2}{16}$ inch. The body is grooved transversely, and has on each side of its upper and lower
surfaces a more or less distinct half-facet for a half-head of a rib. The transverse processes are one inch in length, and have each a concave articular surface on the front of their extremities to receive the tubercle of a rib. The articular processes are sharply defined, their facets nearly circular and flat; the anterior pair face upwards and a little inwards, and the posterior downwards and a little outwards.

Of the ribs, the largest (see Plate VII. fig. 1) is $7 \frac{7}{8}$ inches long and the distance from head to tubercle $1 \frac{3}{10}$ inch; the heads, necks, and tubercles of the ribs are strong and well defined, and there is a well-marked groove on both surfaces ruming almost from end to end of the bones. The tubercle has an articular facet on its posterior face for the transverse process of a vertebra.

Out of the bones of the extremities it is not possible to construct a single paddle; there is only one humerus, no femur, nor are there any other bones of the anterior or posterior girdle.

The humerus is somewhat elongated, flattish, more convex on its outer than on its inner surface, broad below, narrow at the upper end ; in length $3 \frac{1}{2}$ inches, in breadth at the upper end $\frac{3}{4}$ inch, at lower $1 \frac{5}{8}$ inch.

At each end is a pair of articular facets; these are differently disposed. The facets at the upper end differ in size, one occupying the whole of the end, the other being placed at the inner margin of the posterior part of the former; both face upwards and inwards, the lesser one more inwards than the greater; those at the lower end look downwards and inwards, are more on the same plan than the upper pair, and measure respectively 1 inch and $\frac{5}{8}$ inch in length.

As no epiphyses appear on any of these bones of Loxomma, the animal must have been adult, though of rather smaller size than some others the bones of which have been brought to light.
VI. Some of the relations that Loxomma bears to fishes and reptiles having been only incidentally mentioned in the course of this paper, we shall now endeavour to bring together such of them as at present occur to us, who are very far from being deeply versed in the intricacies of comparative anatomy; and in so doing we are bound to acknowledge with gratitude the indispensable assistance we have derived from the standard works of Professors Owen and Huxley.

Loxomma presents all the characters of the order Labyrinthodontia of Owen, except "two occipital condyles" for articulation with the atlas; and it has, besides, other characters which also show its affinity on the one hand with Fishes, and on the other with Batrachians and the higher Reptiles.

Its affinities with Fishes are evidenced by the presence of the following characters:-

By the existence of one concave articular surface, instead of a condyle or condyles, on the posterior face of the basioccipital bone, for articulation with the body of the first cervical vertebra. No atlas has been discovered ; but it may be fairly presumed that the anterior face of its centrum was concave, since all the bodies of vertebre of Loxomma that have been discovered are doubly concave, and the basioccipital itself is also concave behind.

By the existence of two facets on the exoccipitals for articulation with the neural arch of the atlas.

The former of these characters is almost altogether piscine ; it occurs, however, only in Rana among Batrachians (Owen, 'Palæontolog.' p. 208), and is therefore rarely reptilian. The second appears to be exclusively piscine ; for Prof. Owen (Lect. on Comp. Anat. vol. ii. p. 91) says that the "ex-, occipitals are immovably articulated in the cod below with the basioccipital, behind with the neurapophyses of the atlas," also that "in a few fishes (e. g. Fistularia) the exoccipitals send back articular processes modified to allow a slight movement upon the corresponding anterior articular surfaces of the nemrapophyses of the atlas;" but we find no such articulations as these, that we are aware of, in Reptiles. The ossification of the parts here concerned, however, is less perfect in Fishes than in Loxomma.

It seems certain that the mode of articulation of the head to the spinal column has been of such a nature as to allow of only a very limited amount of motion, that Loxomma had little facility in turning its head, and that its movements in this respect resembled rather those of Fishes than of Reptiles.

By the possession of dentigerous vomerine plates on the palate. Lepidosteus and the Batrachia have these; but we also see that "in some alligators (All. niger") the divided vomer extends far forward, expands anteriorly, and appears upon the bony palate" (Owen, 'Anat. of Vertebr.' vol. i. pp. $138 \&$ 146), though it has no teeth.

By the teeth being anchylosed to the bottom of their alveoli, the base of the tooth blending gradually into the bony structure around. This, however, is a reptilian as well as a piscine character. The same may be said of the inequality in height of the outer and inner alveolar borders of the mandible and, to a less degree, of the maxilla also. In Loxomma the inner border of the mandibular alveolus is very deficient, leaving the teeth as it were agglutinated to and supported by the external border only, which stands well up. This character
exists in many fishes ; and in Owen's 'Anatomy of Vertebrates,' vol. i. p. 388, we find, moreover, the following passage bearing on this character, and showing that it is fonnd also in the Batrachia and the Lacertilia :-" In the Scincoids, the safeguards ( $T_{\text {ejus }}$ ), in most Iguanians, in the chameleons, and many Lacertian reptiles the tooth is anchylosed by an oblique surface extending from the base more or less upon the outer side of the crown to an external alveolar plate of bone, the inner alveolar plate not being developed; in the frogs the teeth are similarly but less firmly attached to an external parapet of bone."

In structure the teeth are labyrinthodont.
On the other hand the skull of Loxomma, by its form and size, its strength and solidity of ossification, its peculiarly reticulated surface, and by the massiveness of its mandible, resembles much more the skull of the Crocodilia, and especially of the alligator, than that of Batrachia or Fishes. The presence of limbs as paddles allies it with the orders above Fishes.

The nasal bones are a pair ; the nasal apertures being both anterior and pharyngeal show that Loxomma was an airbreather like the crocodiles; and the existence of such ribs as that figured in Plate VII. fig. 1 confirms this view.

There is no anterior palatine foramen, neither are there posterior palatines or pterygo-maxillary vacuities as in the crocodile and alligator.

The doubtful perforation of the upper jaw in Loxomma is equally suggestive of the actual perforation of the corresponding part in Lepidosteus, and in the old crocodile of the Nile, for the reception of a tooth of the mandible when the mouth is closed.

The apertures in each parietal bone, so large in the Crocodilia, are not present in Loxomma; but the "parietal" foramen, which exists, is a character common to it and the other Labyrinthodonts, to Ichthyopterygia, Sauropterygia, and Anomodontia, but does not belong to Fishes.

The temporal fosse are, in Loxomma as in Crocodiles, Alligators, Tortoises, and Batrachia, placed on the sides of the top of the skull, and are not arched over by bony plates as in the Protopteri and Ganocephala.

The articulations of the mandible with the skull resemble the corresponding parts of the higher reptiles rather than those of fishes.

The large size and great importance of the superior maxillary bones as compared with the premaxillaries is a decided reptilian and not at all an ichthyic character.

The skull of Loxomma has two pairs of bones that are wanting in Fishes and in the Crocodilia, namely the postorbital and the supratemporal; these contribute much to enhance both the length and the breadth of the cranium; they are present, however, in the Ganocephatons Dendrerpeton and Archegosaurus, in the Labyrinthodontia, and in the Ichthyopterygia; but the general ossification of the skull is much further advanced and consolidated in Loxomma than in these other animals, whilst in Archegosaurus, at least, it is very incomplete, having "been chiefly active at the surface" (Owen, Palæont. p. 195).

Besides the above two pairs of bones there is in Loxomma, as in Archegosaurus, another pair, to which attention was called above in the description of the bones, and which lies between the parietals in front and the occipital vertebra behind. This pair is called by Owen, Huxley, and Von Meyer " supraoccipital."

Now, in Loxomma at least (though not in Archegosaurus, on account of incomplete ossification) the occipital vertebra is formed by the basi- and exoccipitals and a fourth piece of triangular form which is the keystone of the arch, and which in consequence we have called the true supraoccipital: the same arrangement exists in the skulls of Crocodiles and Alligators; and in these the occipital vertebra so constituted articulates above with the posterior borders of the parietals, and is more or less overhung by them; but in Loxomma the pair of bones above mentioned is interposed between the arches of the parietal and occipital vertebræ, projecting beyond and overhanging the occipital vertebra exactly as the parietal arch does in Crocodiles \&c.

Is this pair of bones properly designated supraoccipital, though it is actually so in position? Does it belong at all to the occipital or to the parietal vertebra, or is it a pair of dermal bones intercalated between the arches of these two? If it belong to the occipital, then there are three supraoccipitals; if to the parietal vertebra, then this must have had four pieces forming its arch. It seems most probable that it belongs to neither, but is a pair of independent pieces like the postorbitals (if these are not merely subdivisions of the postfrontals) and the supratemporals, and, like them, dermal ossifications, and let in, so to speak, between the regular vertebral arches. They cannot be the paroccipitals of Professor Owen.

That Loxomma had limbs, probably four, in the form of paddles, there can be little doubt; but they were probably not very large or strong; their digits were perhaps not more than four in number. The length of our Loxomma cannot
even approximately be estimated, in the absence of caudal vertebra.

The ribs are long and strong and of reptilian type, showing that the thorax was capacious, and that respiration must have been vigorously carried on by means of diaphragm and lungs.

As no scales or scutes have been found with the remains of Loxomma, the skin may have been soft; perhaps further researches may show that it had some defensive armour.

On the whole we conclude that Loxomma was a rather sluggish Reptile, capable, however, of vigorous movements, and predacions, inhabiting the waters, swimming mostly like a fish, but guided by its paddles, that it breathed air, however, like the Alligators and Crocodiles of modern time. It must find its place in the scale of animals somewhere between Fishes and Reptiles-between the salamandroid fishes and the Crocodilia; for whilst it resembles most the Labyrinthodontia, it possesses characters, more or less important, in common with all the orders lying between Ganocephala and Crocodilia.

It clearly links together, in a very remarkable manner, the two great classes of Fishes and Reptiles, and adds fresh confirmation, if indeed such were needed, to the opinion of Professor Owen that " other extinet orders (Ganocephala and Labyrinthodontia) have demonstrated the artificial nature of the distinctions between fishes and reptiles, and the close transitions that connect together all the cold-blooded vertebrates."

## EXPLANATION OF THE PLATES.

## Plate IV.

Upper surface of cranium of Loxomma Allmami, half the natural size. P.max, premaxillary bone; M.g, mucous grooves; A.n.o, anterior nasal orifices; $N$, nasal bones; Max, maxillary bone; $L$, lacrymal ; Ju, jugal; Quiju, quadrate jugal ; Qu, quadrate; S.t, supratemporal ; O.v, orkital vacuities; $F$, frontal bone; Pr.fr, prefirontal; Pt.fr, postfrontal; Pt.o, postorbital; P, parietals, with parietal foramen; $S q$, squamous; S.o?, supraoccipitals, so-called; Mast, mastoid; T:f, temporal fossa; S.o, supraoccipital ; E.x.o, exoccipital.

## Plate V.

Under surface of cranium of Loxomma, half the natural size. P.max, premaxillary bone; V.t, vomerine tusks; P.p.v, palate-plates of vomers; P.p.p, palate-plates of palate-bones; P.p.max, palateplates of maxillaries; A.max, alveolar border of maxillary; Ap, aperture in palate; P.t, palate-tusks; Sect, section of this tooth shown in Plate VII. fig. ${ }^{5}$; Ju, jugal; Qu, quadrate; Pter, pterygoid; $R$, ridge on median line between palate and pterygoid bones; Ec.pter, ectopterygoid; B.sph, basisphenoid; P.n.o, posterior nasal orifices; B.oc, basioccipital ; Al:cav, articular cavity of ditto for atlas; F.exoe, facets of exoccipital for arches of atlas.

## Plate VI.

Fig. 1. Posterior part of inferior surface of skull of Loxomma, a different specimen from that shown in Plates IV. and V. Natural size. $\mathcal{R}$, ridge on median line, fractured; P.n.o, posterior nasal orifice; B.sph, basisphenoid; B.oc, basioccipital ; Ar.car, situation of articular cavity, here broken away; F.m, foramen macnum, edge of; F.exoc, facets of exoccipitals; Qu, quadrate bone; Mast, mastoid bone; Pter, pterygoid bone.
Fig. 2. External surface right half-mandible of Loxomma, supposed to be of the same specimen as is figured in Plates IV. \& V. Italf natural size. The fractured part, the external end of the articular carity, and the marginal groove along the lower border are well shown.
Fig. 3. Internal surface of fragment of left half-mandible, showing the symphysis, the difference of level between the alveolar borders, the teeth, and the interdental depressions. Half the matural size.
Fig. 4. Dorsal vertebra, natural size. C, centrum ; N.c, neural canal; S.p, spinous process; T.p, transverse process; $A . z$, anterior zygomatic process ; P.z, posterior zygomatic process.

> Plate VII.

Fig. 1. Rib, half the natural size.
Fig. 2. Longitudinal antero-posterior scetion throngh middle of a small tooth and its alveolar border, from right half-mandible, magnified four diameters. $A$, alveolus ; $E$, enamel ; $D$, dentine; $I^{\prime}$, pulpcavity.
Fig. 3. Transverse section near aper of tooth, as indicated in fig. 2, sect. 3. Magnified 16 diameters. $E$, enamel; $D$, dentine; $P$, pulp-cavity.
Fig. 4. Transverse section just above the cessation of the plice, magnified 16 diameters. See fig. 2, sect. 4. $E$, enamel ; $D$, dentine ; $P$, pulp-carity.
Fig. 5. Transverse section immediately below alveolar border, fig. 2, sect. 5. Magnified 16 diameters. $D$, dentine; 1 , pulp-carity; $p$, radiations from pulp-cavity ; $t$, toothlets; $B$, bone.
Fig. 6. Portion of fig. 5, to show minute structure. Magnified about 48 diameters. 13, bone ; cx.l, external layer of dentine; gr.l, granular layer; $D$, dentine, tubular ; ph, plice, long and short; ex.in, external layer infolded ; gr:in, granular layer infolded.
X.-On a new Genus and Species of Bird belonging to the Family Nectariniidæ. By R. Bowdler Sharpe, F.L.S., F.Z.S., \&e., Senior Assistant, Zoological Department, British Museum.

Dr. Alexander Smith has very kindly presented to the Museum some birds received by him from Old Calabar; and amongst other interesting species is one which appears to be the type of a new and undescribed genus. I therefore propose to call it

Lobornis, gen, nov.
The characteristics may be thus, shortly, described. Very close to Pholidornis, and of the same diminutive size, but

